Cast Iron

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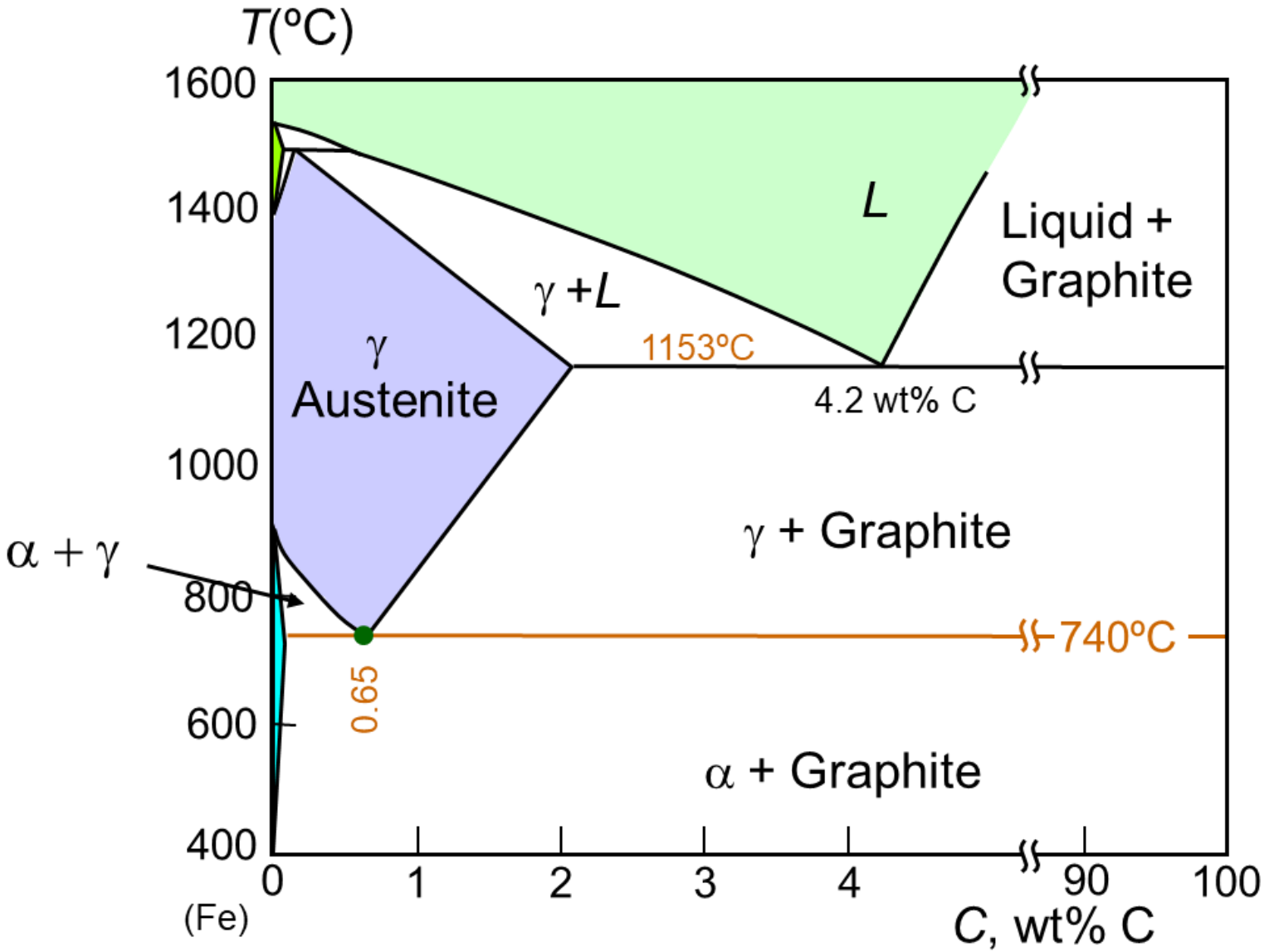
IRON-CARBON SYSTEM FOR CAST IRON

- **More than 1.7 percent carbon**
- **Cast iron contains carbon in free (graphite) or combined form (cementite)**
- **Relatively low cost - No extensive refinement required**
- **Use where high rigidity, resistance to wear and compressive strength are required**
- **Easy to machine**
- **High fluidity**
- **Melting point 1147 – 1250 ^{o}C**

IRON-CARBON SYSTEM FOR CAST IRON



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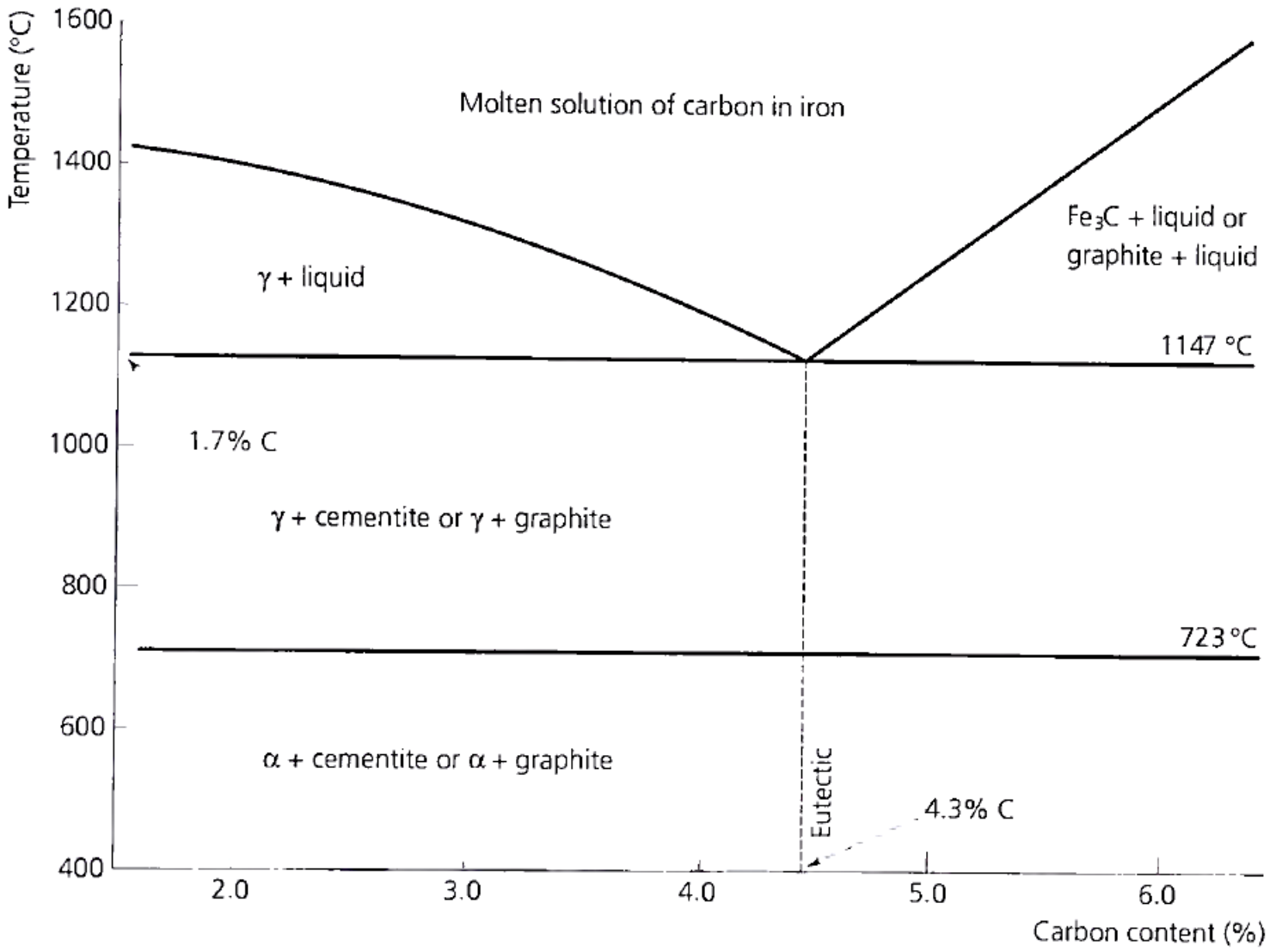
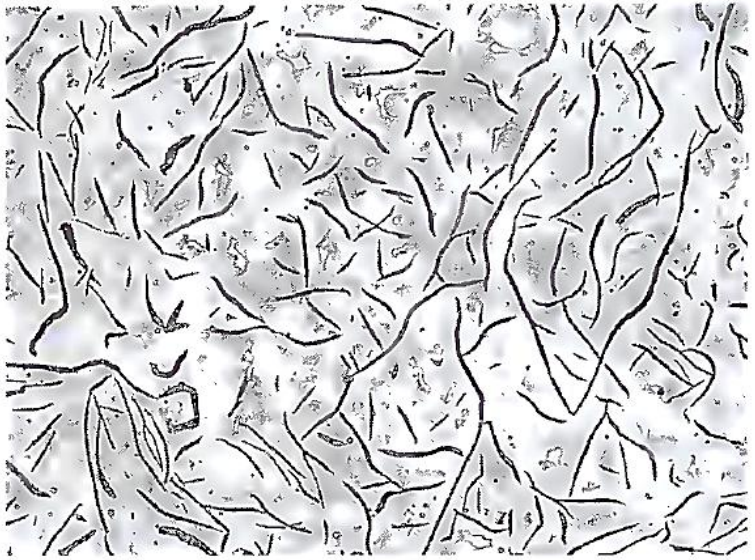


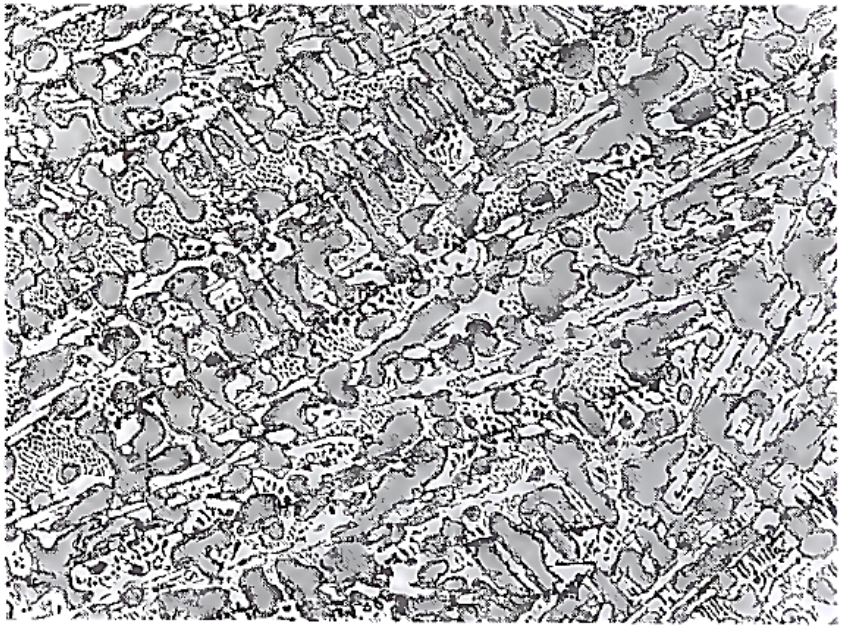
IRON-CARBON SYSTEM FOR CAST IRON

- **Grey cast iron**
  - **Fast Cooling rate**
  - **Ferrite + Pearlite**
  - **Contains carbon in the form of graphite flakes**
  - **Grey fracture surface due to graphite**
  - **Good machinability, excellent damping, brittle in tension**
  - **Engine blocks, machine beds, pipes**



IRON-CARBON SYSTEM FOR CAST IRON

- **White cast iron**
  - **Faster cooling rate**
  - **Cementite + Pearlite**
  - **White crystals of cementite**
  - **Carbon present as cementite (Fe_3C), no free graphite**
  - **Very hard, wear-resistant, brittle**
  - **Crusher liners, mill rolls**



Alloying Elements and Impurities

- **Silicon**
- **Sulphur**
- **Manganese**
- **Phosphorous**

- **Silicon and manganese are alloying elements**
- **Sulphur and phosphorous are impurities**

Silicon

- Soften the cast iron – flakes formation at the expense of cementite
- Provide ease in cooling
- Hardness and brittleness
- Reduce the eutectic composition to 3.5 percent
- Effect of silicon on 3 percent carbon
  - 3 % silicon – ferritic grey cast iron
  - 2 % silicon – ferritic/pearlite cast iron
  - 1.5 % silicon – Pearlitic cast iron
  - No silicon – White cast iron

Sulphur

- Impurity from fuel used in blast furnace
- Stabilizing the cementite and prevent the formation of flakes
- Harden the cast iron
- Formation of iron sulphide – causes embrittlement

Phosphorous

- As impurity from extraction process - Iron Phosphide
- Enhance the fluidity
- 1 % is most suitable for casting
- Causes hardness and embrittlement
- For Shock resistance and strength - low phosphorous

Manganese

- Essential element to combine with residual sulphur
- Soften the cast iron also remove the source of embrittleness
- Additional Manganese imparts hardness to cast iron by stabilizing cementite without causing embrittleness
- Also promotes grain refinement and then increase the strength of cast iron

Malleable Cast Iron

- Produced from white cast iron
- Depending upon different heat treatment process, final composition and structure required
- Carbon converted into temper carbon nodules
- Have increased malleability and ductility
- Increased strength and toughness
- Stronger and less brittle than white iron
- Hand tools, automotive brackets, railway equipment

White cast iron → heat treated (≈ 850–950°C) → cementite breaks down

Alloy Cast Iron

- **Nickel**
  - Grain refinement
  - Add strength
  - Free graphite which toughens the casting
- **Chromium**
  - Stabilize the cementite
  - Increase the hardness and wear resistance
  - Combination of Ni and Cr
- **Copper**
  - Highly soluble
  - Reducing the effect of corrosion

Alloy Cast Iron

- **Molybdenum**
  - Dissolves in ferrite
  - Improve impact strength
  - High amount – formation of double carbide – increase hardness and promotes uniformity of the micro structure
- **Martensite**
  - 4-6 percent Ni + 1 percent Cr
  - Add strength
  - Resist abrasion
  - Machined by grinding
- **Austenite**
  - 11-20 percent Ni+ upto 5 percent Cr
  - Corrosion resistant
  - Heat resistant
  - Tough
  - Non-magnetic